

Factors Associated with Diarrhoea Prevalence in Saudi Arabia

Yagob Y. Al-Mazrou, PhD, FRCGP, **Moslem U. Khan**, PhD, MFCN, **Khwaja M.S. Aziz**, PhD, General Directorate of Health Centres, Ministry of Health, Riyadh, Saudi Arabia, **Samir M. Farid**, PhD, Department of Statistics, City University, London, U.K.

يتميز المناخ في المملكة العربية السعودية بأنه حار جاف معظم أوقات السنة ولا توجد مصادر للمياه السطحية للاستعمال العام والتي قد تساعد في نقل أمراض الإسهال؛ وبالرغم من ذلك فهناك إصابات بأمراض الإسهال في المملكة وحتى وقت قريب فإن تأثير عوامل كثيرة مثل الازدحام ونظف استعمال المياه والإصلاح البيئي. وجودة العناية المنزلية، وطرق التغذية وأماكن الإقامة لم تحظ بالدراسة الكافية.

لقد استعملت معلومات الدراسة الوطنية لصحة الطفل لعام ١٩٨٧م لتحديد دور العوامل السابقة الذكر في الإصابة بأمراض الإسهال بين الأطفال السعوديين أقل من ٦ سنوات.

لقد تمت مقارنة عينة طبقية ممثلة من ٨٥٦٦ امرأة متزوجة من مناطق ريفية ومدنية بوساطة ١٢٠ ممرضة. وقد وجد أن معدل الإصابة بالإسهال هو إصابتان لكل طفل في السنة كما وجد أن معدل انتشار الإسهال بين الأطفال في عمر ٦ شهور وحتى ٢٣ شهراً هو ضعف معدل الانتشار بين الأطفال الأكبر عمراً من ذلك. وكذلك وجد أن معدل الإصابة بين أطفال الريف والمنطقة الجنوبية أكبر من أية منطقة أخرى؛ وإيضاً فإن معدل انتشار الإسهال يرتفع بين الأطفال الذين يتبعون أسلوب التغذية المختلطة وأطفال الأسرة التي يبلغ عدد أفرادها من ٤-١ وكذلك أطفال الأسر التي يعيش ثلاثة أعضاء من أفرادها أو أكثر في غرفة واحدة. وكما أن هناك ارتفاعاً ملموساً في معدل الإصابة بين أطفال الأسر التي تعيش في منازل أرضيتها ترابية. والتي تستعمل مياه الآبار وكذلك الذين يستعملون الأماكن المكشوفة للتبرز. ورغم عدم ملائمة المناخ في المملكة لانتشار العوامل المسببة للإسهال ومحدودية الاستعمال العام للمياه السطحية فإن العوامل المذكورة سلفاً قد ساعدت بشكل واضح في انتشار الإسهال بين الأطفال السعوديين دون ٦ سنوات.

الكلمات المرجعية: الإسهال، العوامل، معدل الانتشار، المملكة العربية السعودية.

The weather of Saudi Arabia is hot and dry for most of the year. The country is devoid of surface water which often help the transmission of diarrhoeal diseases. Nevertheless, this country is not free from diarrhoeal diseases. The role of such factors as crowding, patterns of water use, sanitation, quality of housing, feeding practices and region of residence have not been adequately studied. The 1987 National Child Health Survey data were used to earmark the roles of the aforementioned determinants of diarrhoea in Saudi children aged below six. A stratified and representative sample of 8,566 married women living in rural and urban areas were interviewed by 120 female nurses. There were about two episodes of diarrhoea per child per year. Children aged 6 to 23 months had nearly double the prevalence rate of the older children. Children from rural areas and the southern region had higher rates than children from other areas. Children who were both breast and bottle fed, children of 1-4 member families and of families with 3 or more persons per room had higher prevalence rates. Children of families whose homes had earthen floors, those who used well water and those without toilet facilities who used open fields for defecation had significantly higher rates. In spite of adverse climate and little use of surface water these factors were significantly associated with higher prevalence rates of diarrhoea in Saudi children under six years of age.

Key Words: Diarrhoea, Factors, Prevalence, Saudi Arabia

Correspondence to:

Dr. Yagob Y. Al-Mazrou, Assistant Deputy Minister, Ministry of Health, Riyadh 11176, Saudi Arabia

INTRODUCTION

Diarrhoea is responsible for the deaths of 13 million children annually, and in addition to 500-1,000 million episodes of diarrhoea yearly, it is a major cause of malnutrition¹. Transmission of most diarrhoeal pathogens occurs through the environmental conditions which differ from country to country, John Snow was the first to show that contaminated water was the vehicle of transmission of *Vibrio cholerae* in London². Khan and Mosley observed that the use of surface water was responsible for diarrhoea and cholera^{3,4}. During the most recent pandemic of cholera in South America (1991-1992) the importance of water was reconfirmed⁵. Type of latrines used has been found to be associated with diarrhoea in Saudi Arabia⁶. Improper water storage, use of public water source, distance from water sources, and use of canal water, have been found to be linked with higher diarrhoea incidence⁷⁻⁹. Shigellosis can be contracted in swimming pools, and is also spread by the house fly^{10,11}. Unhygienic food and bottle feeding have been linked with higher diarrhoea prevalence rate⁶⁻¹². The quality and structure of houses, lack of hand washing, soiled diapers and toys left on the ground have also been associated with higher rate of diarrhoea^{13,14}. The route of transmission of agents is therefore very important.

In Saudi Arabia, the most important route of transmission of diarrhoeal agents, the use of surface water is absent since a large section of the population have access to good drinking water and sanitary latrines¹⁵. The Saudi climate is unfavourable for the survival of diarrhoeal agents. Nevertheless, the prevalence rate of about two episodes per child per year is in the vicinity of global average^{16,17}.

An attempt was therefore made to identify the general and environmental factors which may be associated with high prevalence rates of diarrhoea in Saudi Children. The important factors considered were, a) sources of water, b) types of toilets, c) condition of floors, d) child feeding practices, e) family size, f) crowding,

g) area or region of residence, and h) age of children. The data on this were obtained from the country-wide National Child Health Survey of 1987¹⁸.

BACKGROUND

Saudi Arabia stretches over 2,149,690 square kilometres and the 1990 estimated population was over 14.1 million. About 50% of the population is aged under 15 years. The temperature ranges from 0° to 45° Celsius and the annual rainfall is 5.1 to 12.7 cm. The average elevation is between 620 to 1,000 meters above the sea level. The humidity ranges generally from 28% to 60% except in the coastal areas where it is higher for a few months in the year. The sources of water are desalination plants, wells and occasionally, river beds after rain. There are no rivers, canals, or ponds. There are 177 hospitals and 1,702 primary health centres in the country¹⁹. Nearly 70% of the population is urban and the rest rural¹⁸.

MATERIALS AND METHODS

The data used for this study were derived from the Saudi National Health survey¹⁸ which was jointly conducted by the Ministries of Health, Finance and Statistics of Saudi Arabia as part of the Gulf Child Health Survey, in March through May, 1987. A stratified multi-staged sample of 9,061 Saudi households were selected. Out of a population of 59,199 8,482 married women (15-49 years) were to be interviewed. Most of the urban and rural population groups (98%) have access to health facilities in the form of primary health centres (PHC). While selecting the samples, attempts were made to cover almost all the populations served by the health facilities or PHC (about 1,700) located all over the country. All the eligible houses in each locality were numbered and houses earmarked for interview were randomly selected using a table of random numbers. The country was divided into 5 regions: East, West, North, South and Central, and each region subdivided into urban and rural populations.

Using national media, circulars and press releases, the project was publicised to foster cooperation between general public and the survey team. The interviews were conducted by 120 trained female nurses under the supervision of 30 physicians. Sixty percent of the samples were from the urban and 40% from the rural areas. There was a total of 13,140 children under the age of six. However, in the absence of specific information on any required parameter, the children in question were excluded from the study. The reasons for exclusion were refusal to respond to questions' absence of respondents and unavailability of members of the household at the time of interview. Pre-coded and tested questionnaire forms were used to record the events. Analysis was done with ISSA computer package.

Questionnaire included questions on the incidence of diarrhoea in children under six during the two weeks preceding the date of survey, type of drinking water used, types of toilet facility available, kind of flooring in the home, area and regions of residence, number of rooms, number of family members, number of bedrooms, exact age and feeding patterns of children. Diarrhoea was defined according to WHO criteria, as having three or more watery or loose motions or a large single motion containing blood and or excess of mucous in a

24-hour period²⁰. Significance was tested by using chi square tests.

RESULTS

The two-week prevalence rates of diarrhoea in children under six of age and sex are shown on Table 1. Overall, 7.9% male and 7.1% female children had diarrhoea which constituted nearly two episodes (1.95) of diarrhoea per child per year. The rates between the male and female were not significantly different except for a higher rate ($P < 0.05$) in female children aged 18-23 months. The prevalence rate was higher in children aged from 6 to 23 months ($P < 0.01$) than in children of other age groups. The youngest group of children (0-5m) had a lower rate than 6-23 month-old children ($P < 0.005$). The Prevalence rate declined from 8.2% at two years of age to 3.6% at five years. The highest rate (14.3%) was in the age group 12-17 month-old children.

The prevalence rates of diarrhoea in urban-rural and regions of residence and mean duration are shown on Table 2. The regions, central, north, south, east and west, as listed in Table 2 is shown on the map (Figure 1). The rural children had significantly ($P < 0.001$) higher rate (9.2%) than the urban children (6.7%). The rate in children living in the different regions

Table 1
Two Weeks' Prevalence Rate of Diarrhoea in Children under six by Age and Sex

Age	Male	Female	All	Total Annual Episodes	Number of Children
<6 m*	7.4	6.0	6.7	1.74	1,075
6-11 m	15.1	13.5	14.4	3.74	1,244
12-17 m	14.8	14.7	14.7	3.82	1,163
18-23 m	9.8	14.2	11.8	3.07	967
2 Yrs	9.8	6.7	8.2	2.13	2,191
3 Yrs	5.0	4.9	4.9	1.27	2,193
4 Yrs	4.1	4.2	4.1	1.07	2,213
5 Yrs	4.3	2.8	3.6	0.94	2,094
All <6 Yrs	7.9	7.1	7.5	1.95	13,140

$P < 0.001$ (6-23 m vs rest), $P < 0.005$ (<6 m vs 6-23 m), $P > 0.05$ (male vs female)

$P < 0.05$ (male vs female 18-23), *m: months

Table 2

Area of Residence and Two Weeks' Diarrhoea Rates and Mean Duration of Diarrhoea

Residence's Location	Two Weeks Rate Percentage	Annual Episodes per Child	Mean Duration in Days
Urban	6.7	1.74	4.1
Rural	9.2	2.39	4.7
Central	7.7	2.00	3.6
North	6.8	1.77	4.8
South	12.4	3.22	4.7
East	4.9	1.27	5.1
West	6.1	1.59	4.1
All	7.5	1.97	4.3

$P < 0.005$ (South vs the rest), $P < 0.001$ (Urban vs Rural)

varied from 6.1% in the west to 12.4% in the south. The rate in the south was significantly higher ($P < 0.01$) than the rest. The mean duration of diarrhoeal episodes varied from 3.6 days to 5.1 days and the average for all areas was 4.3 days.

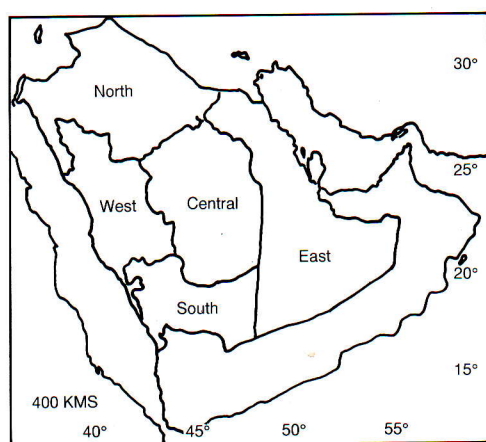


Figure 1. Map of Saudi Arabia showing the five provinces

The average rates of diarrhoea in children according to feeding practices is shown in Table 3. The total rate in "only breast-fed" children was 6.8% and in "only bottle-fed" group was 6.6%. In all the three groups, irrespective of feeding pattern, the rates were highest among the children aged around one year. The rate in "breast-cum-bottle-fed" children was 8.5% and significantly higher ($P < 0.005$) than both the "only breast-fed" and "only bottle-fed" children. The trend of diarrhoea rates in each group continued up to 5 years of age, possibly representing protective effects of breast-feeding in the "breast only" group and the continued high level of care in the "bottle only" group.

The effect of over crowding on diarrhoea prevalence rates is shown in Table 4. It is evident that the rate (12.4%) in children of small households with 1-4 members was higher

Table 3

Two Weeks Diarrhoea Prevalence Rate by Age and Feeding Practice

Feeding Practice	Age in Years & Diarrhoea Percentage						All	No. of Children
	<1	1	2	3	4	5		
Breast Only	10.6	12.4	7.8	4.2	3.0	2.2	6.8	4132
Breast & Bottle	11.6	14.9	9.1	5.5	5.2	4.5	8.5	6541
Bottle Only	10.1	11.3	5.1	6.3	3.3	2.8	6.6	1497
All children	11.3	14.0	8.5	5.3	4.4	3.7	7.9	12170

$P < 0.005$ (Only breast feeding vs breast + bottle feeding), $P < 0.005$ (Only bottle feeding vs breast + bottle feeding)

Table 4
Crowding and Diarrhoea Prevalence Rate in Children under six

Household Variables	No. & % with Diarrhoea	No. with No Diarrhoea	Total Children	P. Value
Family Sizes:				
1-4	127 (12.4)	894	1,021 (a)	a vs b P<0.001
5-9	549 (7.5)	6,767	7,316 (b)	a vs c P<0.001
10 & over	370 (7.4)	4,625	4,995 (c)	
Total	1,046 (7.8)	12,282	13,332	
Persons per room:				
<3	836 (7.7)	10,022	10,858	P>0.05
3 & over	209 (8.5)	2,245	2,454	
Total	1,045 (7.8)	12,267	12,312	
Persons per bedroom:				
<3	223 (7.5)	2,753	2,976	P<0.05
3 & over	825 (8.0)	9,483	10,308	
Total	1,048 (7.9)	12,236	13,284	

than the rate in children of larger households (7.5%) with 5-9 members or with more than 9 members (7.4%). The rate in children belonging to small families was significantly higher ($P < 0.001$) than in children belonging to larger families.

When there were less than three persons per room the rate was lower (7.7%) than in cases where there were three or more persons per

room (8.5%). This difference was significant ($P < 0.05$) statistically. It was clear that the diarrhoea rate in children was lower (7.5%) in cases of less than three persons per bedroom than in cases of three or more persons per bedroom (8.0%). This difference was however not statistically significant ($P > 0.05$).

The use of environmental facilities and diarrhoea rates are shown in Table 5. The

Table 5
Environmental Facilities and the Diarrhoea Prevalence Rates in Children under Six

Environmental Facilities	No. with Diarrhoea	No. with No Diarrhoea	Total Children	X ² and P Values
Floor:				
Cemented	909 (7.5)	11,209	12,118	X ² = 58.64 P<0.001
Earthen	115 (15.3)	637	752	
Total	1,024 (7.9)	11,846	12,870	
Water source:				
Piped/bottled	729 (7.1)	9,505	10,234	X ² = 34.5 P<0.001
Well/river bed	279 (10.6)	2,361	2,640	
Total	1,008 (7.8)	11,866	12,874	
Toilet used:				
Flush	829 (7.4)	10,372	11,201 (a)	a vs b X ² = 2.80 P>0.05 a vs c X ² = 10.88 P>0.001 b vs c X ² = 33.15 P>0.001
Pit (covered)	112 (8.7)	1,174	1,286 (b)	
Open field	92 (13.5)	591	683 (c)	
Total	1,033 (7.8)	12,137	13,170	

diarrhoea prevalence rate was higher (15.3%) in children of families whose homes had earth floors than in children whose homes had cemented floors (7.5%). This difference was statistically significant ($P < 0.001$).

The children of families who used well or pond water had a higher (10.6%) rate of diarrhoea than in children of families who used bottled or piped water (7.1%). This difference was statistically significant ($P < 0.001$).

The diarrhoea rate in children of families who used open fields for defecation was higher (13.5%) than in children of families who had either flush (7.4%) or pit (8.7%) toilets. The differences were statistically significant ($P < 0.001$). The difference between the flush and pit toilet users was however not statistically significant ($P > 0.05$).

DISCUSSION

On the whole, 7.5% of the children under six had had diarrhoea during the two weeks previous to the date of the survey and this constituted nearly two episodes per child per year. Although the rate might not be considered high, for Saudi Arabia, where the weather is hot and the humidity is low and there is practically no surface water often associated with high incidence of diarrhoea, this rate cannot be ignored. Furthermore, using a two-week recall method, the rates for the 6-17-month-old children were close to 4 episodes per child per year which is similar to what is reported in many developing countries. This suggests that the prevalence of diarrhoea in Saudi Arabia is influenced by factors or practices other than those of bad drinking water and adverse weather conditions.

The children living in a rural setting have significantly higher prevalence rate than urban children. The reasons, in the Saudi perspective, may be the differences in socio-economic status of rural and urban populations, culture and hygienic practices for child rearing.

There were no significant differences among four of the provinces or regions in the overall

prevalence rate of diarrhoea. The fifth, the southern province, however had a significantly higher rate than the rest. This is due to the presence of a larger rural population in the south and the availability of fewer social amenities compared to the others¹⁵.

Feeding practices and food^{6,12} have been associated with prevalence rate of diarrhoea. Our results show that 6.8% of those who were breast-fed only had diarrhoea, while 8.5% of those who were fed both breast and bottled milk had diarrhoea ($P < 0.005$). This may be due to the fact that the "breast-only" children are not exposed to environmental diarrhoeal pathogens through feeding, while the mixed feeders are exposed to the diarrhoeal pathogens through supplementary feeding during preparation and presentation of the food by way of the mother's hands¹⁴. Furthermore, we observed that the "bottle-fed only" children had also a lower rate (6.6%) of diarrhoea than the mixed-fed group ($P < 0.005$). These results were unexpected but explained by the fact that the "bottle-fed only" children belonged mostly to educated, working and wealthy mothers. Their child-rearing and food handling practices are also supposed to be more hygienic and better. The lower diarrhoea prevalence rate in western countries is accounted for mainly by hygienic food handling practices.

The transmission of diarrhoeal agents from person to person is influenced by family size and crowding. Our results affirm that the children of small-sized families (1-4) had higher diarrhoea prevalence rate than the bigger-sized families (5-9, 10 and over). This is because the small-sized nuclear families usually consisted of a couple with one or two young children in whom diarrhoea rate is very high (Table 1), while the families with larger number of members consisted of older children have significantly lower susceptibility to diarrhoea. The age of the children therefore appears to determine the prevalence rate of diarrhoea.

Our results show that rate of diarrhoea was significantly ($P < 0.05$) lower in children in

families with less than three members per room than in those in families with three or more members per room. This is because two persons sharing a room are likely to be a married couple or older members of a family in whom the incidence of diarrhoea is low, while families with three or more members are likely to include young children in whom the incidence of diarrhoea is high. The age of children is therefore significant. The study also showed trend of a lower rate ($P>0.05$) in children in families with less than three members sleeping in a bedroom than with three or more persons per bedroom. But the number of people per room appears to be more important than number per bedroom where they only went to sleep. This is so because rooms include hallways or living rooms in which the children often congregated and remained in close contact to play during waking hours promoting the spread of disease. The age factor examined by a subsequent countrywide study showed that the last child by order of birth under the age of five had almost double the rate of diarrhoea¹⁹ compared to older siblings.

The type of accommodation has been associated with prevalence rate of diarrhoea¹⁶. Our results show that the children who live in houses with earth floors had a higher rate of diarrhoea ($P<0.001$) than children living in houses with concrete floors. The reason is that the agents are easily transmitted through dust. This also confirms the findings that young children living in houses, where the toys were left on ground, had higher rate of diarrhoea¹⁴.

Water has long been associated with diarrhoea^{2-5,9-11}. Although sources of water in Saudi Arabia (desalinated water) are different from the usual sources in other countries. The result shows that the users of well water had higher prevalence rate of diarrhoea than the users of bottled or piped water (desalinated). Most of the wells in this country are located at levels lower than their surroundings. In addition to contamination by bird droppings and buckets used in drawing the water, the position of the

well permits seepage of rain water from the surrounding areas. The use of well water may thus help in the transmission of pathogens. This means that though there is no surface water like canals or rivers in Saudi Arabia, there is no death of diarrhoeal agents in this country²¹.

In other studies the type of toilets used has been shown to be an important factor in pathogen transmission^{7,8}. Our results also show that in an area where open fields are used for defecation there was a significantly higher prevalence rate of diarrhoea than in homes where children used flush and pit (covered) toilets. However, there was no significant difference between the users of flush and pit latrine with regard to prevalence of diarrhoea. In this country however, flush toilets differ from pit latrines only in as far as one has a flushing system and the other does not. Agents from exposed stools may be transmitted through dust, rain water, insects¹⁵ and vermin which are not absent from the environment. Food handlers may also play a role in the transmission of diarrhoeal agents.

We thus observe that, although the normal sources of surface water present in other places are absent here and the environment does not promote the growth and survival of diarrhoeal agents, there are other factors which aid the survival and spread of these agents and their survival in the environment. The factors identified in the study are age, poor rural and southern homes where conveniences are lacking, earth floors, mixed feeding, small-sized families, over crowding, use of well water and the use of open fields for defecation.

It can be concluded that despite the virtual absence of surface water, high temperatures for most of the year, and relatively low humidity in non-coastal areas, diarrhoeal disease rates are similar to the rates in some developing countries. This study has drawn attention to some social and environmental problems which can be dealt with through health and social education. Further studies to investigate diarrhoea rates in

6-23 months olds only with special emphasis on the influence of over crowding will be of great benefit.

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